Curb Ramp Inspection System & Related Pedestrian Access topics

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Agenda

- Curb Ramp Inspection System (CIS)
  - PennDOT Measurement Approach (Grace)
  - CIS background, development, and status (Duvall)
- Pedestrian Access for People with Disabilities (Duvall)
  - Background & Motivation
  - Tailored Navigation
  - Sidewalk Roughness
  - Route Accessibility Index
  - Putting it all together
Traditional ADA Ramp Measurements

Issues:
- Labor Intensive
- Typically Two Inspectors Preferred
- Variability With Manual Measurements
- Data Manually Captured On Paper
- Data Transferred To Excel Spreadsheet
Traditional ADA Ramp Measurements

Data Entry:
- CS-4401 Excel Spreadsheet
- Provides Feedback For Values Entered
- Photos Then Attached
- Form Saved In Our System Of Record

Needs:
- More Efficient
- Less Labor
- Less Repeat Data Entry
- Reduce Return Visits
Generation 1 CIS

Nexus Tablet with Android applications on scooter mount. Tablet includes accelerometer to measure grades.

Arduino Uno with Sonar Sensor for vertical distance measurements.

Micro Kickboard Compact scooter

Encoder for horizontal distance measurements

Power supply
Generation 1 CIS
PennDOT Funding (6/’17 – 11/’18)

Task 1: Design Review of CIS [complete]
Task 2: Finalize CIS Design [complete]
Task 3: Construct & Test Beta prototype of CIS [ongoing]
Task 4: Revise CIS Design
Task 5: Literature Review [complete]
Task 6: Needs Assessment [ongoing]
Task 7: Pilot Data Gathering
Task 8/9: Final Report
Task 1: Design Review of CIS

**Methods:** 5 volunteers used CIS to measure curb-ramp attributes

1. **Usability**
   - Reduce Size & Weight
   - Improve UI to make more interactive

2. **Durability**
   - Strengthen joints
   - Make weather-proof

3. **Data Integrity**
   - External accelerometer, and sensors close to ground
Task 2: Finalize CIS Design: Hardware
Task 2: Finalize CIS Design: Software
Task 2: Finalize CIS Design: Software
Task 3: Construct & Beta Testing

Construct

• Device Completed

Ongoing Beta Testing

• Experienced data collectors
• Train on CIS & have them test the system
• Gather feedback on performance and revisions

→ Task 4: design revisions
Timeline Moving Forward

Task 1: Design Review of CIS
Task 2: Finalize CIS Design
Task 3: Construct & Test Beta prototype of CIS (7/2018)
Task 4: Revise CIS Design (9/2018)
Task 5: Literature Review
Task 6: Needs Assessment (7/2018)
Task 7: Pilot Data Gathering (9/2018)
Pedestrian Access for People w/ Disabilities

Assessing the Influence of Wheelchair Technology on Perception of Participation in Spinal Cord Injury
Eliana S. Chaves, MS, Michael L. Boninger, MD, Rosemarie Cooper, MPT, ATP, Shirley G. Fitzgerald, PhD, David B. Gray, PhD, Rory A. Cooper, PhD

Table 3: Factors That Limit Access to Community and Transportation

<table>
<thead>
<tr>
<th>Factors</th>
<th>Is your access to leaving your home to go out into the community limited by . . .</th>
<th>Is your access to using transportation limited by . . .</th>
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<td>Limited finances</td>
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<td>Social attitudes</td>
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</table>
Pedestrian Access for People w/ Disabilities

- 1:3 older Americans trip annually
- TBI most frequently a result of trips/falls (35.2%)
- $30B of direct medical costs are related to falls annually
- Among WC users
  - Tips/falls are most common source of injury
  - 2x more likely to have back or neck pain
Sidewalk Roughness: Background

Research article
Health risks of vibration exposure to wheelchair users in the community

Yasmin Garcia-Mendez¹,²,⁵, Jonathan L. Pearlman¹,³,⁴, Michael L. Boninger¹,²,³,⁴, Rory A. Cooper¹,²,³,⁴
Sidewalk Roughness: Outcomes

Pathway Measurement Tool (PathMET)
Navigation Tools For People/W Disabilities

Table 1 Wheelchair navigation map database components

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<tr>
<th>Category</th>
<th>Measure</th>
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<tr>
<td>Building accessibility</td>
<td>Curb ramp, Door (auto or manual)</td>
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<tr>
<td>Sidewalk</td>
<td>Sidewalk condition (cracks, potholes, materials), Sidewalk congestion (pedestrian traffic), Sidewalk geometry (clear width, grade, cross-slope, step)</td>
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<tr>
<td>Curb</td>
<td>Curb (height), Curb cuts (width, slope), Landing (length)</td>
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<tr>
<td>Lighting</td>
<td>Visibility</td>
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<tr>
<td>Handicap parking</td>
<td>Parking space (width), Passenger loading zone (width)</td>
</tr>
<tr>
<td>Bus</td>
<td>Bus stop accessibility, Bus route accessibility</td>
</tr>
</tbody>
</table>

Design Considerations for a Personalized Wheelchair Navigation System

Dan Ding, Member, IEEE, Bambang Parmanto, Hassan A. Karimi, Duangduen Roongpiboonsopit, Gede Pramana, Thomas Conahan, Piyawan Kasemsuppakorn
Route Accessibility Index: Background

Fig. 1. Example of Google Maps walking directions

Fig. 2. Image showing a possible pathway on Google Maps

Development of Route Accessibility Index to Support Wayfinding for People with Disabilities

Jonathan A. Duvall¹,²(✉), Jonathan L. Pearlman¹,², and Hassan A. Karimi³

© ICST Institute for Computer Sciences, Social Informatics and Telecommunications Engineering 2016. A. Leon-Garcia et al. (Eds.): Smart City 2015, LNICST 166, pp. 104–112, 2016. DOI: 10.1007/978-3-319-33581-7_9
Route Accessibility Index: Outcome

\[ d \times \left[ \left( \text{max HC/HC limit} \right) + \left( \text{Ave. CS)/(CS limit} \right) + \left( \text{Ave.RS)/(RS limit} \right) + \left( \text{Ave.RO)/(RO limit} \right) \right] \]

Fig. 3. Image showing three routes chosen for analysis

Table 2. Results of Route Accessibility Index analysis

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Putting it all together
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